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NATIONAL ENFORCEMENT INVESTIGATIONS CENTER  
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August 1, 2024

**MEMORANDUM**

**SUBJECT:** Modeling toxic air contaminant concentrations from evaporation of process wastewaters in retorts at the J.H. Baxter Eugene facility  
Work Product No.: NEICRP2080X01

**FROM:** Bradley Venner, Ph.D., Statistician  
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**TO:** Karla Perrin, Regional Criminal Enforcement Counsel, EPA-Region 10

**Summary**

Polychlorinated dibenzo-p-dioxin and furan (PCDD/F) compounds are produced as inadvertent contaminants in technical-grade pentachlorophenol<sup>1</sup>. Polycyclic aromatic hydrocarbon (PAH) compounds are present in creosote<sup>2</sup> and Bunker C fuel oils<sup>3</sup>. Pentachlorophenol, cresote and Bunker C fuel oils were used by J.H. Baxter in their wood treatment processes at their facility in Eugene, Oregon. Some of the PCDD/F and PAH compounds were released into process wastewater during wood treatment process. Some of these process wastewaters were evaporated in retorts by J.H. Baxter, primarily in 2019 but at various other times in previous years, bypassing at least some components of the permitted wastewater treatment process.

This document presents a model of the atmospheric concentrations of PCDD/F and PAH compounds that could have been released from evaporation of process wastewaters in the retorts. Emission rates are estimated using available measurements of PCDD/F and PAH concentrations in process wastewaters and a model of the retort evaporation process. Air concentrations are estimated using AERMOD, an USEPA air dispersion model designed for short-range dispersion of pollutants from industrial sources. When possible, the modeling approach follows the guidance documents developed by the Oregon Department of Environmental Quality (ODEQ) for compliance with the Cleaner Air Oregon Program. This approach was followed by J.H. Baxter during their efforts to comply with the program prior to closing the plant, including the preparation of a modeling protocol document that was submitted to the Lane Regional Air Protection Agency in 2021<sup>4</sup>.

<sup>1</sup> Johnson, 2017

<sup>2</sup> Environment Canada, 1992

<sup>3</sup> IARC, 1989

<sup>4</sup> JBAX-US\_0011813

### ***Emissions Rates***

The J.H. Baxter Eugene facility operated under a zero-discharge permit, meaning that no process wastewaters were allowed to be sent to Eugene municipal sanitary or stormwater systems. Therefore, the standard practice at J.H. Baxter was to treat process wastewaters on-site and then evaporate the treated waters. The process wastewater treatment system began with an oil-water separator [OWS 32-B] who's contents were pumped into a primary settling tank [Tank 41A] and then to a holding tank [Tank 42B]. The contents of the holding tank were then sent to a caustic basin where pH was adjusted, an alum basin, a clarifier, a clearwell, two parallel carbon filters and then to an evaporator feed water tank [Tank 43C]. The contents of Tank 43C were sent to an evaporator that was operated at a setpoint of 110 °F<sup>5</sup>.

According to the Amended Notice of Civil Penalty Assessment and Order<sup>6</sup>,

*14. On 175 days from approximately December 2015 through October 2019, Respondent pumped approximately 1.7 million gallons of liquid process waste containing the chemical mixtures described above to retorts 81, 82, 83 and 85 at the Facility, bypassed the pollution controls on the retorts, and operated the retorts to heat and "boil off," or evaporate, the waste.*

According to **Adult Witness** when the retorts were used to boil off water, they were set to a temperature between 212 and 220 °F<sup>7</sup>. On top of the retorts were four feet tall, 4" diameter exhaust stacks with gate valves, which were always locked down during wood treatment. When used for evaporation, water was boiled and evaporated through the exhaust stacks. **Adult** said the retorts had a site glass, and when the water level was about a quarter full, more water was added while the retort kept boiling. **Adult** said water was boiled until tanks 41A, 42B and 43C were low enough in volume.

### ***Generated process wastewater volumes***

Systematic records of the volume of process wastewater that was generated at the facility do not appear to have been kept by J.H. Baxter. Therefore, these volumes must be estimated from information available in the record.

One source of information on the volume of generated process wastewaters is a detailed breakdown of the sources of process wastewater for three weeks in February 2019 in an email from **Adult Witness** to **Adult Witness**. **Adult** identified sources of process wastewater whose volume depended on the amount of rainfall that fell on process areas (hereafter process stormwater) and other sources whose volume depended on the amount of wood processed (hereafter wood treatment process wastewater).

**Adult** identified two major sources of process stormwater. The first is rainfall that fell in process areas, which was captured and treated in the process wastewater treatment system. **Adult** estimated that the 6.5 inches of rainfall that fell in the period would result in more than 122,000 gallons of water considering "just the exposed area of the tank farm." The number of square feet of process area assumed by **Adult** can be obtained from the general relationship,

$$V \text{ (gal)} = 7.48 \text{ (gal/ft}^3\text{)} \times H \text{ (ft)} \times A \text{ (ft}^2\text{)}$$

where V is the volume in gallons, H is the height in feet and A is the area in square feet. Using the

<sup>5</sup> JHB Process Water Presentation.pptx, JBAX-US\_0008719

<sup>6</sup> DEQ Case No. LQ/HW-WR-2020-204, Bates No. JBAX-US\_0000322

<sup>7</sup> JBAX-US\_0008658

<sup>8</sup> JHB\_GJ\_036788



volume of process stormwater and amount of rainfall given by **Adult** gives a process area of 30,111 ft<sup>2</sup> (122,000 gal/(7.48 gal/ft<sup>3</sup> × 0.542 ft)). **Adult** also estimated that rainwater infiltration added an additional 10% to this volume. Therefore, process stormwater volume (RW) as a function of inches of rainfall R can be estimated as:

$$RW \text{ (gal)} = R \text{ (in)} \times 30,111 \text{ (ft}^2\text{)} \times 1.1/12 \text{ (in/ft)} = R \text{ (inch)} \times 20,646 \text{ (gal/inch)}$$

For wood treatment process wastewater, **Adult** stated he used a “condensed water analysis” using the amount of wood processed for a single week to estimate a produced water volume of 10,000 gallons. Since the record does not contain sufficient detail to reconstruct the relationship between production volume and produced water volume, I assumed that this volume was produced each week. **Adult** also identified drip pad washing as producing 460 gallons of process water a week.

**Adult** also identified 79,000 additional gallons of water were produced in February 2019 by the steam traps failing to open in Retort 82.<sup>9</sup>

The total volume of process water produced per month under regular operations can be estimated as

$$PW \text{ (gal/month)} = \text{weeks/month} \times 10,460 \text{ (gal/week)} + R \text{ (in)} \times 20,646 \text{ (gal/inch)}$$

I obtained records of monthly rainfall in Eugene from the National Weather Service<sup>10</sup> and used these to calculate the process wastewater that would have been produced in 2017, 2018, and 2019 by month using the methodology provided by **Adult**. The average volume of process stormwater per year was about 720,000 gallons. The wood treatment process wastewater on an annual basis would be about 540,000 gallons of water.

A second source of information on the volume of generated process wastewater is from an email from **Adult Witness** to **Adult Witness** which contained a portion of a spreadsheet that estimated the relationship between rainfall amounts and process stormwater for 10 months in 2015<sup>11</sup>. The relationship was 21,150 gallons/inch, about 2.4% higher than the estimate of 20,646 gallons/inch provided by **Adult**.

A third source of information is from an email from **Adult Witness** to **Adult Witness** in 2021.<sup>12</sup> This email contained estimates of both process stormwater and wood treatment process water volumes. **Adult** estimated that the facility generated 720,364 gallons of wood processing wastewater in 2019, based on volumes “measured in the hot wells and recorded in the TRDB”. Converting the annual estimate to a weekly estimate gives 13,853 gallons/week. **Adult** also estimated that one inch of rainfall would produce about 31,000 gallons of process stormwater. Both of **Adult** estimated annual volumes are higher than the estimated annual volumes using **Adult** methodology, and the relationship between rainfall and process stormwater volume was higher than the relationship that **Adult** gave in 2015.

Since **Adult** estimates are the lowest of the three estimates I found in the record, I will use this approach to estimate process wastewater volumes. Table 1 shows the volumes of process wastewaters generated in 2019 calculated using **Adult** methodology.

<sup>9</sup> JHB\_GJ\_036788

<sup>10</sup> <https://www.weather.gov/media/pqr/climate/ClimateBookEugene/pg69.pdf>

<sup>11</sup> JHB\_GJ\_049135

<sup>12</sup> JHB\_GJ\_005343. This email referenced an attached spreadsheet “Process Water Via Treatment 2019-2020.xlsx”, which I was not able to locate.



*Volume of Process Wastewaters Evaporated in the Retorts*

J.H. Baxter identified the days that the retorts were scheduled to be used to evaporate process wastewaters in monthly production schedules, although the volume of water that was evaporated does not appear to have been systematically recorded. The ODEQ prepared a spreadsheet that identified the days that the retort was recorded by J.H. Baxter as evaporating process wastewater<sup>13</sup>. ODEQ identified 6 occasions where the retorts were used for evaporation between 2015 and 2018. These events lasted from three to five days. In 2019, the frequency of these events increased, with 3 events in January and one event in February. Sometime in March of 2019, the evaporator unit failed<sup>14</sup> and was eventually replaced sometime in October of 2019<sup>15</sup>. Every day from March 6 to April 30, 2019, at least one retort was recorded as being used for “boiling off water” in the production schedule. Retort use declined after this, with only one recorded event in August. In total, retort evaporation was recorded on the production schedule on 136 days between 1/1/19 and 8/6/19. On 20 of these days, two retorts were identified and on 2 of these days three retorts were identified. I confirmed the ODEQ spreadsheet against the monthly J.H. Baxter production schedules from 2016 to 2019<sup>16</sup>.

Although no retort evaporation events were recorded after 8/7/19, several emails from Adult Witness to the Boiler Room suggested that retort evaporation continued. An email on 9/27/19 instructed to “keep 81 boiling water”<sup>17</sup>. An email on 9/20/19 instructed to “strip out 81 as much as possible and begin filling with water from either tank 36 or 25”<sup>18</sup>. An email on 8/23/19 instructed to “keep water boiling off and draining hot wells in 81.”<sup>19</sup> Since the number of retort evaporation days are not recorded, I did not include these months in the evaporation rate estimates. This results in a conservative emissions rate estimate for the year.

Some retort evaporation events may have occurred that were not recorded prior to 8/6/19. An email from Adult Witness to the Boiler Room on 1/4/19 instructed to “continue to boil water in 82 as long as possible on Saturday while finishing up treating.” The production schedule indicated that boiling stopped on 1/4/19. Since this was a Thursday, two more days of evaporation may have occurred. An email from Adult Witness to Adult on Friday, 2/15/19 stated that “We are treating in [Retort] 82 through Saturday night(ish) and then immediately starting to boil off water in [Retort] 82 for the next two weeks.” The production schedule only indicated evaporation for one week starting on 2/18/19. An email from Adult Witness to the Boiler Room on 4/19/19 instructed to “boil water” in Retort 81<sup>20</sup>. The production schedule indicated that Retort 83 was boiling water for the entire month but did not include Retort 81.

I estimated the number of hours of retort operation by assuming that boiling commenced at 8:00 AM on the first day the retort was identified as “boiling off water” and ended at 5:00 PM on the last day. When the same retort was used in consecutive days, then I assumed that boiling was continuous.<sup>21</sup> The

<sup>13</sup> JBAX-US\_0008714

<sup>14</sup> JBAX-US\_0008658

<sup>15</sup> JHB\_GJ\_027703. The cooling tower arrived at the facility on 8/23/2019 (JHB\_GJ\_004561).

<sup>16</sup> JHB\_GJ\_002174-002215, JHB\_GJ\_002218-002222. All days identified by ODEQ were in the production schedule. I identified two additional single day events in the production schedules that were not included on the ODEQ spreadsheet on 2/4/2016 and on 3/18/2016.

<sup>17</sup> JHB\_GJ\_027712

<sup>18</sup> JHB\_GJ\_027724

<sup>19</sup> JHB\_GJ\_027766

<sup>20</sup> JHB\_GJ\_027956

<sup>21</sup> See attached file “RP2080X01 Boiling Events.xlsx”



results of these calculations are listed in Table 1.

Since the evaporator was not operational for much of 2019, I assumed that all process wastewaters were routed to the retorts after 3/1/19 and that process wastewater storage areas were at capacity prior to this date. I used the three water tanks used in the process wastewater system: Tank 41A, Tank 42B, and Tank 43C. The capacity of each tank was identified as 20,000 gallons<sup>22</sup>, and the total storage would be roughly 60,000 gallons.

The wastewater evaporation rate from the retorts can be calculated from the sum of the monthly process water volume estimates in Table 1, excluding process water volumes in January and February but including process wastewater storage, and dividing by the total number of hours of evaporation of all retorts. From this evaporation rate, I calculated the volume evaporated in January and February of 2019 by multiplying by the hours of operation in each month and assumed that the balance of water was sent to the evaporator. An iterative calculation gives an evaporation rate of 190 gallons/hour.<sup>23</sup>

There are indications that other tanks were used for process wastewater storage in emails from [REDACTED] to the Boiler Room. An email on 4/8/19 stated "keep very close watch on the hose currently draining water from tank 9 into the tank 20 tank farm...Tomorrow we will work on getting some of that water put in tank 20-a and 20-b."<sup>24</sup> The modeling protocol document includes a list of buildings and tanks<sup>25</sup>. According to this document, tank 9 would be "PCP Work Tank no. 9". Tank 20 would be "PCP Work Tank no. 20". Tanks 20A and 20B would be "Base Oil Storage Tank no." 20A and 20B. An email on March 5, 2019, stated "[REDACTED] will continue to pump water from the South tank farm into 25". 25 would be "PCP Work Tank no 25". An email from June 21, 2019, stated "keep (retort) 85 boiling water from either C tank, 36 or 25." Tank 36 would be "ACA Work Tank no. 36". An email from [REDACTED] to [REDACTED] and Georgia Baxter on 4/24/19 stated "the containment walls ... have been holding water while we deal with not having an evaporator." The use of these tanks for process wastewater storage would allow for more process stormwater to be stored and would allow for a higher evaporation rate.

The evaporation rate calculation is based on the idea that the rate limiting step in the evaporation process is moving water vapor through the exhaust stacks. [REDACTED] a former employee of J.H. Baxter, stated that the retort evaporation process caused a "loud, whistling noise that resembled the sound of a tea kettle." The modeling protocol document stated that the exhaust stacks on each retort used for evaporation had the same diameter despite the differences in the tank capacity<sup>26</sup>. Therefore, the evaporation rate should be independent of tank capacity.

Table 1 shows the estimated volume evaporated in the retorts.

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<sup>22</sup> JHB\_GJ\_002364

<sup>23</sup> See attached file "RP2080X01 Boiling Events.xlsx"

<sup>24</sup> JHB\_GJ\_027976

<sup>25</sup> JBAX-US\_0011813

<sup>26</sup> JBAX-US\_0011813



**Table 1: Estimated Process Water Production Volumes  
J.H. Baxter Eugene Facility, 2019**

2019	Rainfall	Stormwater	Wood Process	Extra	Evaporator	Total	Retort	Retort Gallons/month @ 190 gallons/hour	Emissions Factor
Month	Inches	Gallons	Gallons	Gallons	Gallons	Gallons	Hours		Unitless
Jan	3.23	66,687	46,323		-71,000	42,010	219	41,610	0.507
Feb	8.00	165,169	41,840	19,000	-206,000	20,009	105	19,950	0.269
Mar	1.09	22,504	46,323	60,000		128,827	904	171,760	2.092
Apr	7.34	151,543	44,829			196,371	708	134,520	1.693
May	2.41	49,757	46,323			96,080	518	98,420	1.199
Jun	0.35	7,226	44,829			52,055	538	102,217	1.287
Jul	0.23	4,749	46,323			51,071	242	45,980	0.560
Aug	0.56	11,562	46,323			57,885	153	29,070	0.354
<b>Total</b>	<b>23.21</b>	<b>479,197</b>	<b>363,111</b>	<b>79,000</b>	<b>-277,000</b>	<b>644,309</b>	<b>3387</b>	<b>643,527</b>	

The methodology used by ODEQ to calculate the volume of process wastewater evaporated in the retorts for the civil complaint gives a larger evaporation rate than the evaporation rate methodology described above. ODEQ calculated the total amount of water evaporated by assuming that the retorts were initially filled 2/3 full and that the volume of water was evaporated over the duration of operation.<sup>27</sup> This methodology is most directly applicable when there are discrete evaporation events. Table 2 shows the 10 retort evaporation events identified by ODEQ prior to March 2019. The hours of operation were calculated in the same manner described above, assuming that the event started at 8:00 AM of the day that evaporation began and ended at 5:00PM of the day that evaporation event ended. The average evaporation rate calculated for these 10 events using this methodology is 278 gallons.

I used the lower rate of 190 gallons/hour in the modeling calculations described below.

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<sup>27</sup> JBAX-US\_0000085



Table 2: Retort Process Wastewater Evaporation Events J.H. Baxter Eugene Facility, Dec 2015 – Feb 2019							
Year	Month	Event Start	Event End	Hours	Retort Number	2/3 Full Retort Volume (Gallons)	Gallons /Hour
2015	12	12/28/15 8:00	12/30/15 17:00	57	83	21,997	255
2016	1	1/4/16 8:00	1/6/16 17:00	57	83	21,997	255
2016	2	2/8/16 8:00	2/11/16 17:00	81	83	21,997	179
2016	3	3/21/16 8:00	3/25/16 17:00	105	81	33,840	213
2017	4	4/24/17 8:00	4/28/17 17:00	105	81	33,840	213
2018	12	12/26/18 8:00	12/28/18 17:00	57	81	33,840	392
2019	1	1/2/2019 8:00	1/4/2019 17:00	57	81	33,840	392
2019	1	1/7/2019 8:00	1/11/2019 17:00	105	82	36,598	230
2019	1	1/14/2019 8:00	1/16/2019 17:00	57	82	36,598	424
2019	2	2/18/2019 8:00	2/22/2019 17:00	105	82	36,598	230
						<b>Average</b>	<b>278.2</b>

*Process water treatment prior to evaporation in the retort*

There are conflicting statements in the record on the treatment of process wastewaters prior to evaporation in the retorts. **Adult** stated that “any rainwater that fell in the secondary containment was pumped to either tanks A or B along with process water.” Tank A likely refers to Tank 41A and Tank B likely refers to Tank 42B. Process water was placed in Tank 43C prior to evaporation in a retort and transferred to a retort with hoses.<sup>28</sup>

However, this treatment practice may not always have been followed. **Adult** said the water that was boiled in the retorts did “not always” run through the wastewater treatment system first. He explained if the tank farm was filling up, “we needed to get rid of the water” before the tank farm overflowed. **Adult** said in this situation, the treatment system could never keep up.<sup>29</sup>

The record contains several emails from **Adult** to the Boiler Room that imply that Tank 43C was not always the only source of the process wastewater evaporated in the retorts. An email from 2/25/19 stated to “begin filling [Retort] 82 with water from the South tank farm.”<sup>30</sup> Although Tank 43C is in the South Tank Farm, this sentence would allow for other sources. An email from 6/21/19 instructed to pull water from “either tank [43]C, 36, or 25 (priority is in that order).”<sup>31</sup> It is not clear if the water in these other storage tanks were treated. In an email on 7/19/19, **Adult** said “The main task for the weekend is to get all of the water/oil mixture in the South tank farm moved into tank 25 ... Ideally, it would have been nice to run it through the separator first but we ran out of time ...”<sup>32</sup> An email from 7/26/19 stated to “keep [Retort] 81 boiling water and add water from either [42]B tank or tank 20 tank farm as necessary.”<sup>33</sup> It is not clear that water from the Tank 20 tank farm was treated prior to evaporation.

<sup>28</sup> JBAX-US\_0008658

<sup>29</sup> JBAX-US\_0008685

<sup>30</sup> JHB\_GJ\_028047

<sup>31</sup> JHB\_GJ\_027865

<sup>32</sup> JHB\_GJ\_027822

<sup>33</sup> JHB\_GJ\_027808



### *Contaminant concentrations in process water*

Process wastewaters were sampled by personnel from Maul Foster & Alongi, Inc. a subcontractor to J.H. Baxter, on two occasions in 2021 as part of a larger study of potential air emission sources undertaken for compliance with the Cleaner Air Oregon program. A February sampling event included sampling process wastewaters from the evaporator influent (EVAP-01 and EVAP-01-DUP). A June sampling event included sampling waters from the influent to the carbon filters (CFI-01) and collecting an additional sample from the evaporator influent (EVAP-02). The samples were analyzed for semi-volatile analytes, which includes PAHs, by EPA Method 8270 (D or E) and for PCDD/F compounds by EPA Method 1613B, by the RJ Lee Group, Inc. Analytical results were reported in a memo from Maul Foster & Alongi to LRAPA dated 10/21/2021<sup>34</sup> (hereafter “the analytical report”).

The analytical results for PAH compounds from the 8270D analyses of EVAP-01 and EVAP-01-DUP were not provided in the analytical report. Only phenol was reported from these analyses at the request of Maul Foster.<sup>35</sup> The PAH compounds were reported to Maul Foster & Alongi on 4/15/19 in “Revision 1” of the analytical report.

According to the analytical report, sometime between the February and June sampling, the carbon media in the carbon filters was replaced. This change appeared to increase the removal efficiency of the carbon filters for PCDD/F compounds, as the analytical results from sample EVAP-02, collected in June, are lower than those from EVAP-01, collected in February. The PCDD/F concentrations in EVAP-01 more closely resemble the concentrations in CFI-01, a sample from the carbon filter influent that was collected in June. Because the PAH results from EVAP-01 were not available in the record at the time of this writing, the removal efficiency of the carbon filters on PAHs cannot be directly evaluated. However, since in general the PAH compounds have lower affinity for binding organic carbon than the PCDD/F compounds, it is likely that the PAH compounds were less likely to be filtered by the carbon filter media present in the filters in Feb 2021. Furthermore, **Adult** stated in an email that on 2/15/19 there was only one working carbon filter, shortly after samples were collected.<sup>36</sup> Therefore, I believe that the carbon filter influent concentrations are more representative than the evaporator influent concentrations for the PAHs and PCDD/F compounds of process wastewaters placed in the retort.

Table 3: Process Wastewater Sampling Locations and Analyses J.H. Baxter Eugene Facility, 2021				
Date	Process Stream	Sample IDs	Analytes (Method)	Notes
Feb, 2021	Evaporator Influent	EVAP-01, EVAP-01-DUP	Dioxins (1613B), Phenol(8270D)	Only phenol was reported from the 8270D analyses. PAHs were initially reported but then withheld.
Jun, 2021	Evaporator Influent	EVAP-02	Dioxins (1613B), PAHs (8270E)	Samples were collected subsequent to replacement of carbon filter media
Jun, 2021	Carbon filter influent	CFI-01	Dioxins (1613B), PAHs (8270E)	

<sup>34</sup> JBAX-US\_0005551

<sup>35</sup> JBAX-US\_0005511, p. 83

<sup>36</sup> JHB\_GJ\_028047



*Modeling emissions rates from the retort evaporation process*

Mathematical modeling of the emissions rates of PAH and PCDD/F compounds from the retorts requires calculating the vapor phase concentrations of the compounds from the measured concentrations of the compounds in the liquid water phase. Although Maul Foster & Alongi proposed to use TOXCHEM to calculate VOC emissions rates from the process wastewater treatment system, a “USEPA-approved and DEQ-approved software for water treatment systems”<sup>37</sup>, the retorts are not a standard wastewater treatment unit and cannot easily be represented within TOXCHEM. Therefore, I developed a custom model for the retort evaporation system.

The model was written in the Julia programming language using the ModelingToolkit library<sup>38</sup>. This library allows for the high-level specification of systems that can be solved with a differential-algebraic solver. Differential-algebraic models are used for modeling chemical kinetics when chemical reactions can be partitioned into “fast” and “slow” reactions. The fast reactions are then modeled as algebraic equations that describe quasi-equilibrium conditions, while the slow reactions are modeled as differential equations. Partitioning between different phases was modeled as algebraic equations while the transport of water vapor from the retort was modeled as a differential equation. Partitioning was modeled using the fugacity approach to multimedia fate and transport models.<sup>39</sup> The code for this model is attached.<sup>40</sup>

The emissions rates of compounds from the boiling retorts were modeled as the product of the concentration of the compound in the water vapor phase times the transport rate of water vapor from the retort (i.e. rate that water vapor is produced by the evaporation of liquid water in the retort). The concentration of a compound in the vapor phase is related to the concentration of a compound in the liquid phase by the air-liquid partitioning, whose value is described by the Henry’s constant.

In addition to the gas and liquid phases, I included a suspended solids phase, since PCDD/F and PAH compounds are known to partition to these phases.<sup>41</sup> The ratio of the concentration of a compound in the suspended solid phase to the concentration in the liquid phase can be estimated by the octanol-water partition coefficient ( $K_{ow}$ ) times the fraction of organic carbon in the suspended solid. I used a volume fraction of 1 part per million for the suspended solids based on the default values suggested by Mackay<sup>42</sup>.

The temperature dependence of the Henry’s constant can be modeled with the van’t Hoff equation for temperature effect on an equilibrium constant.<sup>43</sup> The slope of the relationship depends upon the enthalpy of vaporization of the compound.

Some compounds ionize in aqueous solutions in proportion to the pH of the solution. The relation between the amount of ionization and the pH of the solution is given by the acid (or base) disassociation constant. The ionized compound does not partition to the vapor phase. Although most PCDD/F and PAH compounds do not ionize, an important exception is pentachlorophenol, which is a component of one of the treatment processes used at the plant.

The five main parameters required for each compound are the Henry’s constant, the temperature

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<sup>37</sup> JBAX-US\_0011813

<sup>38</sup> <https://github.com/SciML/ModelingToolkit.jl>

<sup>39</sup> Mackay, et. al., 2006a, Cahill et. al., 2002

<sup>40</sup> See attached file “RP2080X01 Fugacity Model.jl”.

<sup>41</sup> Mackay, et. al., 2006b

<sup>42</sup> Mackay, et. al., 2006a

<sup>43</sup> ten Hulscher, 1992

dependence of the Henry's constant, the octanol-water partition coefficient, the molecular weight, and the disassociation constant. The main source I used was the Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals.<sup>44</sup> I also used on-line resources such as PubChem<sup>45</sup> and henrys-law.org<sup>46</sup>. The values used in the model for these constants were saved into a comma-separated value file.<sup>47</sup>

I solved the model for 28 PCDD/F and PAH compounds that were detected in the carbon filter influent analysis for a boiling event of three days in duration and determined the percentage of the compound that was transferred in this time. Although there was a wide range of rate constants over this collection of compounds, there was not sufficient information regarding the timing of evaporation events to model the kinetics in greater detail, so the evaporation rate was modeled as a constant rate over the event. Thus, the total mass of contaminant in the volume was multiplied by the percentage of the compound that was transferred and divided by the duration of evaporation to give a constant emissions rate over the duration. The calculated emissions rates are given in Table 6.

### ***Air Dispersion Modeling***

PCDD/F and PAH air concentrations were modeled at various receptor locations using the atmospheric dispersion software AERMOD. There are several reasons this software was selected. First, this software is recommended by USEPA for modeling near-field atmospheric dispersion. Second, this software was recommended by the Cleaner Air Oregon program that J.H. Baxter was called into on Dec 2, 2019. A detailed guidance document called *Recommended Procedures for Air Quality Dispersion Modeling* was developed by ODEQ for applying AERMOD for the program<sup>48</sup>. Third, J.H. Baxter made steps to comply with this program by developing a modeling protocol document; this document contains plant-specific data that can be used in AERMOD.

I used AERMOD View, version 4.2 and AERMET View, version 12.0.0, by Lakes Environmental Software, which implement a graphical user interface to the USEPA versions of AERMOD and AERMET, respectively. Lakes Environmental Software provided me with complimentary copies as an USEPA employee. AERMOD View interfaces to various supplementary models that are used to develop inputs to AERMOD, including AERSURFACE. AERMOD View uses SI (metric) units in its input files, so the quantities that are specified in J.H. Baxter's documents in US customary units must be converted to SI units to be used in the model. Both unit systems will be presented in the following when necessary for clarity.

### ***Source Description***

Retort evaporation emissions were modeled as a point source in AERMOD. The system temperature was taken as the boiling point of water. The stack location and height for the retorts were taken from the Modeling Protocol<sup>49</sup>. Because the retorts are close together and the use of different source locations would greatly increase the complexity of the model, I used the location of Retort 81 for all emissions.

A water vapor flow rate of 340 L/s (0.340 m<sup>3</sup>/s) as calculated from the liquid water evaporation rate

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<sup>44</sup> Mackay, et. al., 2006b.

<sup>45</sup> <https://pubchem.ncbi.nlm.nih.gov/>

<sup>46</sup> <https://henrys-law.org/>

<sup>47</sup> See attached file "RP2080X01 Fugacity Constants.csv".

<sup>48</sup> Oregon Department of Environmental Quality, 2022

<sup>49</sup> JBAX-US\_0011813



of 0.20 liters/second (190 gallons/hour), using the equation:

$$F_g [L/s] = F_l [L/s] \cdot \rho [kg/L] \cdot R [L \cdot atm / (K \cdot mol)] \cdot T [K] / (VP[atm] \cdot MW [mol/kg])$$

$$\frac{(0.20 \frac{L}{s})(1 \frac{kg}{L})(1000 \frac{g}{kg})(0.08206 \frac{L \cdot atm}{mol \cdot K})(373.2 K)}{(18.02 \frac{g}{mole})(1 atm)} = 340 \frac{L}{s}$$

where the temperature of the system is the temperature of boiling water (212 °F, 100 °C, 373.2 K), the vapor pressure of boiling water is 1 atm, the molecular weight of water is 18.02 g/mol, and the gas constant is 0.08206 L·atm/(K·mol).

The stack inner diameter of the retorts was stated to be 3 inches in the Modeling Protocol. **Adult** stated in an interview that the stacks were 4 inches in diameter. Using the four-inch diameter value<sup>50</sup>, the area of the pipe in SI units would be

$$0.00811 m^2 = \left( \frac{4}{2} in \times 0.0254 \frac{m}{in} \right)^2 \times \pi$$

This gives a gas exit velocity of 41.9 meters/second (.340 m<sup>3</sup> / .00811 m<sup>2</sup>). This velocity is about 12% of the speed of sound (343 m/s), so the flow can be modeled as an incompressible fluid.<sup>51</sup> The increase in pressure required to achieve this exit velocity can be modeled using the Bernoulli equation<sup>52</sup>:

$$P_1 + \frac{1}{2} \rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2} \rho v_2^2 + \rho g h_2$$

$$P_1 + 0 + 0 = P_2 + \left( \frac{1}{2} \right) \left( 0.804 \frac{kg}{m^3} \right) \left( 41.9 \frac{m}{s} \right)^2 + \left( 0.804 \frac{kg}{m^3} \right) \left( 9.8 \frac{m}{s^2} \right) (1.22 m)$$

$$P_1 - P_2 = 715 Pascals$$

Therefore, the stack restriction would result in about a 0.7% increase over atmospheric pressure (1.020E5/1.013E5 = 1.0071).

Table 4: Parameter Values for Bernoulli Equation for Increase in Tank Pressure Due to Restriction				
Symbol	Description	Unit	1 (tank)	2 (exit)
P	Pressure	Pascals	1.036E5	1.013E5
ρ	Density	kg/m <sup>3</sup>	0.804	0.804
v	Velocity	m/s	0	74.5
g	Gravity	m/s <sup>2</sup>	9.8	9.8
h	Height	Meters	0	1.22

The Modeling Protocol document stated that that the water vapor exit flow rate was .024 m<sup>3</sup>/s with an exit temperature of 389 K. This exit flow rate is unlikely since it would only move about 5% of the total capacity of the tank in a three-day period.

Since the emissions rate varied based on the amount that the retorts were used each month, I

<sup>50</sup> The larger diameter was chosen since the smaller diameter results in an exit velocity of 74.6 m/s. This value is larger than the maximum value of 50 m/s allowed in AERMOD, so the impact of this smaller value on air concentrations cannot be evaluated within the model.

<sup>51</sup> [https://en.wikipedia.org/wiki/Mach\\_number](https://en.wikipedia.org/wiki/Mach_number)

<sup>52</sup> <https://pressbooks.uiowa.edu/clonedbook/chapter/the-most-general-applications-of-bernoullis-equation/>

calculated an average evaporation rate based upon the total amount of water evaporated in the retorts divided by the total number of seconds in the 8-month period that was modeled. I then calculated an emissions factor by dividing the monthly evaporation rate by the average evaporation rate. The calculated monthly emissions factors are shown in Table 1 and were entered into AERMOD View.

### *Meteorological Data*

AERMOD requires two types of meteorological data. The first is hourly surface wind data and the second is upper air profile data. These data are processed by the AERMET preprocessor to create a surface met data file (file extension SFC) and a vertical profile data file (file extension PFL).

I used the Eugene Airport as the source of surface wind data. The USAF ID for the Eugene airport is 726930, the WBAN ID is 24221 and the International Civil Aviation Organization (ICAO) airport code is KEUG. I downloaded hourly surface data from the National Center for Environmental Information using the Amazon S3 endpoint for the year 2019.<sup>53</sup> AERMOD View can supplement hourly data with five-minute and one-minute ASOS<sup>54</sup> data using the AERMINUTE auxiliary program. I obtained both one-minute<sup>55</sup> and five-minute surface data<sup>56</sup> for the Eugene Airport location from the National Center for Environmental Information website. These files are organized by month; for each month there is a folder containing data organized by their ICAN airport code. I downloaded 12 months of five-minute data and the 9 months of one-minute data that were available.

For the upper air profile data, I used the Salem Municipal Airport as the source for radiosonde station. This station was also used in the Modeling Protocol document. I downloaded the data from National Center for Environmental Information.<sup>57</sup>

### *Building Locations and Downwash*

AERMOD View can calculate downwash effects of buildings using the embedded BPIP-PRIME model, which is embedded in AERMOD View. I used the information provided in the Modeling Protocol, Table 4-3, to identify building name, base elevation, and height. I then used the annotated maps in Figure 3-1 and 3-2 in the Modeling Protocol to identify building location. I then used Google Earth to obtain the locations of the buildings and their sizes. I placed this information into a Microsoft Excel spreadsheet that can be imported into AERMOD View.<sup>58</sup>

### *Terrain Model and Receptor Locations*

AERMOD View can calculate the effects of local terrain using the embedded AERMAP model. I accessed USGS digital elevation model (DEM) at a 7.5 minute scale (approximate resolution of 30 meters) from the interface to the WebGIS website in the AERMAP terrain processor within in AERMOD View.

I used a similar grid spacing proposed in the Modeling Protocol, which was based on the ODEQ guidance document *Recommended Procedures for Air Quality Dispersion Modeling*,<sup>59</sup> but excluded the

<sup>53</sup> <https://noaa-isd-pds.s3.amazonaws.com/data/2019/726930-24221-2019.gz>

<sup>54</sup> Automated Surface Observing System

<sup>55</sup> <https://www.ncei.noaa.gov/data/automated-surface-observing-system-one-minute-pg1/access/2019/>

<sup>56</sup> <https://www.ncei.noaa.gov/data/automated-surface-observing-system-five-minute/access/2019/>

<sup>57</sup> <https://www.ncei.noaa.gov/data/integrated-global-radiosonde-archive/access/data-por/USM00072694-data.txt.zip>

<sup>58</sup> See attached file "RP2080X01 Buildings.xlsx"

<sup>59</sup> Oregon Department of Environmental Quality, 2022



largest nested grid. The grid spacing is shown in Table 5.

Table 5: AERMOD Receptor Modeling Nested Grid Locations	
Receptor Spacing	Receptor Distance
25 m	Along fence line and out at least 200 m from fence line
50 m	200 m to 1,000 m
100 m	1,000 to 2,000 m
200 m	2,000 to 5,000 m

### *Air Concentrations and Risk Estimates*

I ran AERMOD with the inputs described above using a unit emissions rate of 1 g/s. AERMOD calculated both the maximum 24-hour air concentration and the annual average air concentration for each proposed receptor point. ODEQ guidance calls these values a unit emissions concentration.<sup>60</sup> A chemical-specific air concentration from a chemical-specific emissions rate is obtained by dividing the actual calculated emissions rate by the unit emissions concentration. The software generates contour maps from the resulting concentrations. These contour maps were exported from AERMOD as KML files and located over the affected area using Google Earth Pro.

Figure 1 shows a contour map of the modeled 24-hour maximum air concentrations over the year for an emissions rate of 1 gram per second. The unit air concentration for this model was 283 ug/m<sup>3</sup> for an emissions rate of 1 gram/second, which was observed in the residential area to the north of the plant. The outer contour represents an air concentration of 17 ug/m<sup>3</sup>.

Figure 2 shows a contour map of average air concentrations over the year for an emissions rate of 1 gram per second. The unit air concentration for this model was 20 ug/m<sup>3</sup> for an emissions rate of 1 gram/second, which was observed in the residential area to the north of the plant. The outer contour represents an air concentration of 3 ug/m<sup>3</sup>.

I calculated chemical-specific maximum 24-hour and annual average air concentrations for each of the 28 detected compounds by dividing the compound-specific emissions rate by the respective unit emissions rate. These calculations were performed in Microsoft Excel<sup>61</sup> and the resulting concentrations are shown in Table 6.

Table 6 also shows the air concentrations calculated using the Level 1 risk assessment dispersion factors from Table 3A for annual exposure and Table 3B for 24-hour exposure from the Oregon Administrative Rules §340-245-8010. The published values are 0.00075 ug/ m<sup>3</sup> / pounds/year and 2.4 ug/m<sup>3</sup> / pounds/day from Table 3A and Table 3B, respectively for an exposure location distance of 130 meters and a stack height of 5 meters. The exposure location distance of 130 meters is approximately the distance between the exposure source and residential housing to the north of the facility, and the stack height is the closest value to the 4 m stack height on the retorts. These Level 1 dispersion factors do not include any site-specific information and are intended to provide a screening-level risk assessment. The site-specific air concentrations are lower than the Level 1 derived air concentrations.

<sup>60</sup> Oregon Department of Environmental Quality, 2022

<sup>61</sup> See file "RP2080X01 Emissions Rates.xlsx"

Table 6: Calculated Air Concentrations with Comparison to OAR Screening-Level Default Dispersion Factors

Analyte	Carbon Filter Influent Conc	Carbon Filter Influent Units	% Transfer	Emissions Rate mg/s	ODEQ Level 1 24-hour Conc (ug/m <sup>3</sup> )	AERMOD 24-hour Conc (ug/m <sup>3</sup> )	ODEQ Level 1 Annual Conc (ug/m <sup>3</sup> )	AERMOD Annual Conc (ug/m <sup>3</sup> )
1-Methylnaphthalene	4,140	ug/L	100%	0.32	1.46E-01	9.05E-02	0.0169	0.0064
2-Methylnaphthalene	8,530	ug/L	100%	0.66	1.37E-01	1.86E-01	0.0348	0.0132
2-Methylphenol	2,180	ug/L	100%	0.17	3.49E-02	4.77E-02	0.0089	0.0034
Acenaphthene	5,940	ug/L	100%	0.46	9.51E-02	1.30E-01	0.0242	0.0092
Acenaphthylene	64	ug/L	100%	0.00	1.03E-03	1.41E-03	0.0003	0.0001
Anthracene	1,250	ug/L	100%	0.10	2.00E-02	2.73E-02	0.0051	0.0019
Benzo(a)anthracene	645	ug/L	100%	0.05	1.03E-02	1.41E-02	0.0026	0.0010
Benzo(a)pyrene	166	ug/L	100%	0.01	2.66E-03	3.63E-03	0.0007	0.0003
Benzo(b)fluoranthene	205	ug/L	100%	0.02	3.28E-03	4.48E-03	0.0008	0.0003
Benzo(k)fluoranthene	209	ug/L	100%	0.02	3.35E-03	4.57E-03	0.0009	0.0003
Biphenyl	1,770	ug/L	100%	0.14	2.84E-02	3.87E-02	0.0072	0.0027
Carbazole	1,650	ug/L	100%	0.13	2.64E-02	3.61E-02	0.0067	0.0025
Chrysene	605	ug/L	100%	0.05	9.69E-03	1.32E-02	0.0025	0.0009
Dibenzofuran	3,310	ug/L	100%	0.26	5.30E-02	7.24E-02	0.0135	0.0051
Fluoranthene	4,240	ug/L	100%	0.33	6.79E-02	9.27E-02	0.0173	0.0066
Fluorene	2,940	ug/L	100%	0.23	4.71E-02	6.43E-02	0.0120	0.0045
Naphthalene	14,600	ug/L	100%	1.13	2.34E-01	3.19E-01	0.0595	0.0226
Pentachlorophenol	389,000	ug/L	0.10%	0.03	6.23E-03	8.50E-03	0.0016	0.0006
Phenanthracene	6,530	ug/L	100%	0.50	1.05E-01	1.43E-01	0.0266	0.0101
Quinoline	35,300	ug/L	100%	2.73	5.65E-01	7.72E-01	0.1440	0.0545
OCDD	1,816,667	pg/L	6%	8.52E-06	1.77E-06	2.41E-06	4.50E-07	1.70E-07
OCDF	2,410,000	pg/L	6%	1.13E-05	2.34E-06	3.20E-06	5.97E-07	2.26E-07
1,2,3,4,6,7,8-HpCDD	403,667	pg/L	10%	3.07E-06	6.36E-07	8.68E-07	1.62E-07	6.14E-08
1,2,3,4,6,7,8-HpCDF	214,667	pg/L	100%	1.65E-05	3.42E-06	4.67E-06	8.72E-07	3.30E-07
1,2,3,4,7,8,9-HpCDF	14,833	pg/L	100%	1.14E-06	2.37E-07	3.23E-07	6.02E-08	2.28E-08
1,2,3,4,7,8-HxCDD	3,797	pg/L	82%	2.40E-07	4.97E-08	6.79E-08	1.27E-08	4.80E-09
1,2,3,4,7,8-HxCDF	2,533	pg/L	88%	1.72E-07	3.58E-08	4.88E-08	9.10E-09	3.45E-09
1,2,3,6,7,8-HxCDD	26,867	pg/L	82%	1.70E-06	3.52E-07	4.80E-07	8.96E-08	3.39E-08
1,2,3,7,8,9-HxCDD	13,633	pg/L	82%	8.61E-07	1.79E-07	2.44E-07	4.55E-08	1.72E-08



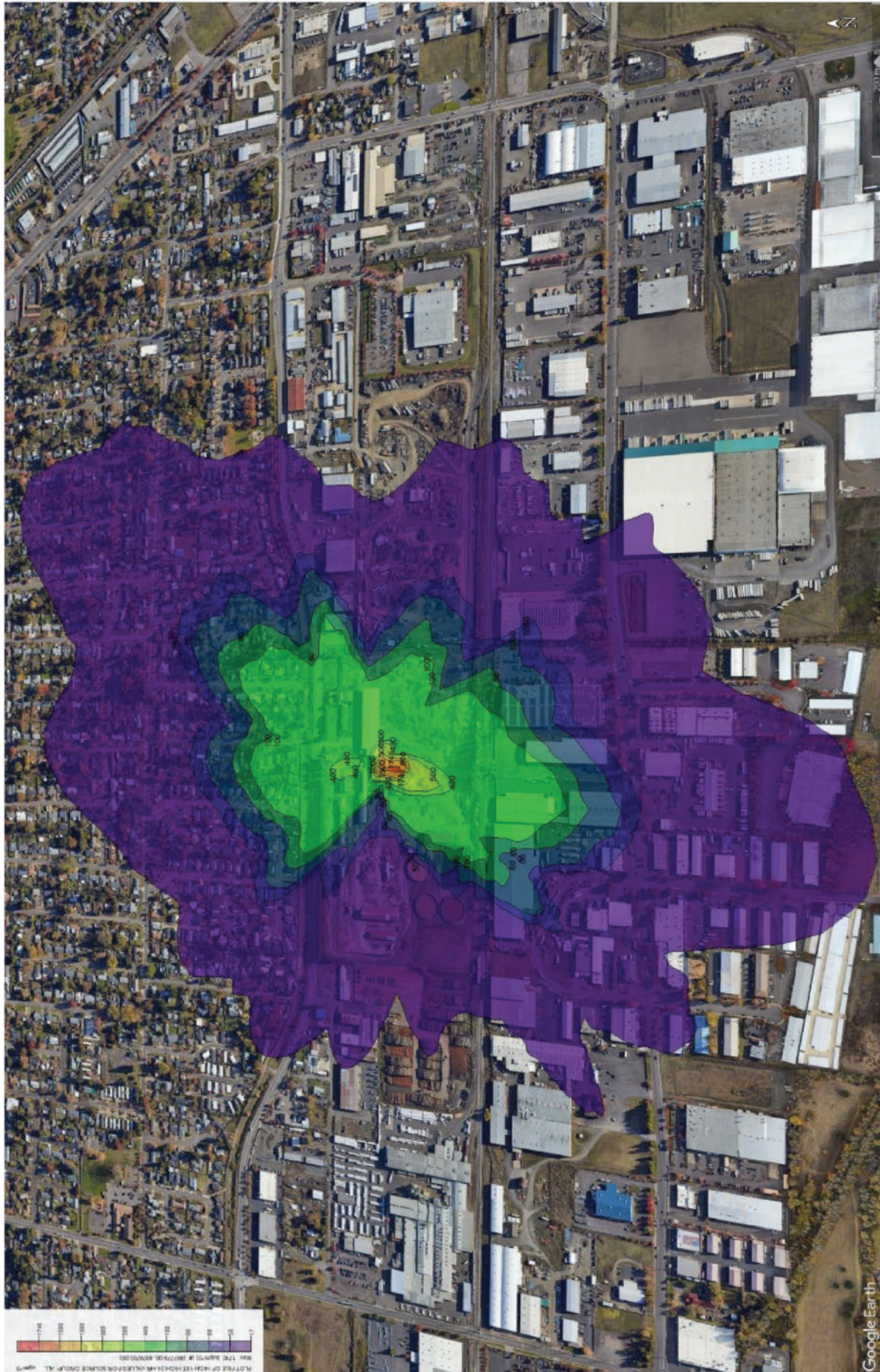






Figure 2: Modeled air concentrations averaged over one year for an emissions rate of 1 gram per second. The unit air concentration for this model was  $20 \text{ ug/m}^3$  for an emissions rate of 1 g/s. The outer contour represents an air concentration of  $3 \text{ ug/m}^3$ .



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Attachments	
Filename	Description
RP2080X01 Fugacity Constants.csv	Comma-separated value spreadsheet containing parameters used for fugacity partitioning model.
RP2080X01 Fugacity Model.jl	Julia source code for fugacity partitioning model.
RP2080X01 Buildings.xlsx	Microsoft Excel spreadsheet containing building parameters for import into AERMOD.
RP2080X01 Emissions Rates.xlsx	Microsoft Excel spreadsheet containing calculations of emissions rates and air concentrations. Basis of Table 6
RP2080X01 Boiling Events.xlsx	Microsoft Excel spreadsheet containing calculations of process water production and evaporation rate. Basis of Table 1

Grand Jury Documents Cited			
Bates No	Date	Description	File Name
JBAX-US_0000085		DEQ Monthly Log Summary	DEQ Monthly Log Summary.xlsx
JBAX-US_0000322	5/4/2022	ODEQ amended notice of civil penalty	
JBAX-US_0005551	10/21/2021	Liquid-oil sampling results	
JBAX-US_0008658	7/11/2023	Interview with Adult Witness	
JBAX-US_0008685	8/31/2023	Interview with Adult Witness	
JBAX-US_0008714		DEQ Retort Evaporation Summary and Notes	
JBAX-US_0008719	10/27/2020	Fig 8 - Process Flow Diagram	
JBAX-US_0011813	2/2/2021	Modeling Protocol prepared by Maul Foster & Alongi	IAR0058Attachment - Attachment 1 Modeling Protocol of JHB.pdf
JHB_GJ_002364	12/1/2020	Spill Prevention, Control and Countermeasure Plan	
JHB_GJ_004561	8/23/2019	Email from Adult Witness to Adult Witness and Georgia Baxter	The evaporative cooling tower arrived this morning
JHB_GJ_005343	9/23/2020	Email from Adult Witness to Adult Witness re: process water volumes	
JHB_GJ_002174		Production schedule	7 July 2016.xlsx
JHB_GJ_002175		Production schedule	B NOV 2016.xlsx
JHB_GJ_002176		Production schedule	4 APRIL 2016.xlsx
JHB_GJ_002177		Production schedule	9 SEPT 2016.xlsx
JHB_GJ_002178		Production schedule	5 May 2016.xlsx
JHB_GJ_002179		Production schedule	A OCT 2016.xlsx
JHB_GJ_002180		Production schedule	1 JANUARY 2016.xlsx
JHB_GJ_002181		Production schedule	8 AUGUST 2016.xlsx
JHB_GJ_002182		Production schedule	2 FEBRUARY 2016.xlsx
JHB_GJ_002183		Production schedule	3 March 2016.xlsx
JHB_GJ_002184		Production schedule	C DEC 2016.xlsx
JHB_GJ_002185		Production schedule	2 FEB 2017.xlsx
JHB_GJ_002186		Production schedule	4 APRIL 2017.xlsx
JHB_GJ_002187		Production schedule	9 SEPT 2017.xlsm
JHB_GJ_002188		Production schedule	B NOV 2017.xlsm
JHB_GJ_002189		Production schedule	7 JULY 2017.xlsm
JHB_GJ_002190		Production schedule	A OCT 2017.xlsm
JHB_GJ_002191		Production schedule	5 MAY 2017.xlsx
JHB_GJ_002192		Production schedule	3 MARCH 2017.xlsx
JHB_GJ_002193		Production schedule	1 JAN 2017.xlsx
JHB_GJ_002194		Production schedule	C DEC 2017.xlsx
JHB_GJ_002195		Production schedule	6 JUNE 2017.xlsx
JHB_GJ_002196		Production schedule	8 AUGUST 2017.xlsm
JHB_GJ_002197		Production schedule	8 AUGUST 2018.xlsm
JHB_GJ_002198		Production schedule	6 JUNE 2018.xlsm



Grand Jury Documents Cited			
Bates No	Date	Description	File Name
JHB_GJ_002199		Production schedule	3 MARCH 2018.xlsm
JHB_GJ_002200		Production schedule	C DEC 2018.xlsm
JHB_GJ_002201		Production schedule	5 MAY 2018.xlsm
JHB_GJ_002202		Production schedule	A OCT 2018.xlsm
JHB_GJ_002203		Production schedule	1 JANUARY 2018.xlsm
JHB_GJ_002204		Production schedule	4 APRIL 2018.xlsm
JHB_GJ_002205		Production schedule	9 SEPT 2018.xlsm
JHB_GJ_002206		Production schedule	7 JULY 2018.xlsm
JHB_GJ_002207		Production schedule	B NOV 2018.xlsm
JHB_GJ_002208		Production schedule	2 FEB 2018.xlsm
JHB_GJ_002209		Production schedule	1 JAN 2019.xlsm
JHB_GJ_002210		Production schedule	C DEC 2019.xlsm
JHB_GJ_002211		Production schedule	3 MARCH 2019.xlsm
JHB_GJ_002212		Production schedule	8 AUGUST 2019.xlsm
JHB_GJ_002213		Production schedule	6 JUNE 2019.xlsm
JHB_GJ_002214		Production schedule	A Oct 2019.xlsm
JHB_GJ_002215		Production schedule	5 MAY 2019.xlsm
JHB_GJ_002218		Production schedule	2 FEB 2019.xlsm
JHB_GJ_002219		Production schedule	B NOV 2019.xlsm
JHB_GJ_002220		Production schedule	7 JULY 2019.xlsm
JHB_GJ_002221		Production schedule	9 Sept 2019.xlsm
JHB_GJ_002222		Production schedule	4 APRIL 2019.xlsm
JHB_GJ_027703	10/3/2019	E-mail from Adult Witness to Boiler Room	Weekend Treating 10/5/19
JHB_GJ_027712	9/27/2019	E-mail from Adult Witness to Boiler Room	Weekend Treating 9/27/19
JHB_GJ_027724	9/20/2019	E-mail from Adult Witness to Boiler Room	Weekend Treating 9/21/19
JHB_GJ_027766	8/23/2019	E-mail from Adult Witness to Boiler Room	Weekend Treating 8/24/19
JHB_GJ_027808	7/26/2019	E-mail from Adult Witness to Boiler Room	Weekend Treating 7/27/19
JHB_GJ_027822	7/19/2019	E-mail from Adult Witness to Boiler Room	Weekend Treating 7/20/19
JHB_GJ_027865	6/21/2019	E-mail from Adult Witness to Boiler Room	Weekend Treating 6/22/19
JHB_GJ_027956	4/19/2019	E-mail from Adult Witness to Boiler Room	Weekend Treating 4/20/19
JHB_GJ_027976	4/8/2019	E-mail from Adult Witness to Boiler Room	Water from 9 to 20 TF
JHB_GJ_028047	2/15/2019	E-mail from Adult Witness to Boiler Room	Weekend Treating/Evaporating
JHB_GJ_036788	2/26/2019	Email from Adult Witness to Adult Witness & Adult Witness	RE: Water Flooding Update & Water Inflow/Evap Analysis
JHB_GJ_049135	11/10/2015	Email from Adult Witness to Adult Witness	2015 Rainfall Evaporation Cost
JHB_GJ_035060	9/29/2019	Email from Adult Witness to Adult Witness and Georgia Baxter	Cooling Tower Update